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RESEARCH ARTICLE

Determination of Officer of the Watch Selection Criteria for Ship Types

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ABSTRACT

Maritime education is given in accordance with the Training, Certification, and Watchkeeping Standards of Seafarers (STCW) around the world. These standards provide seafarers with the necessary licenses and certificates to work on board but their operational performance depends on their personal characteristics and qualifications. In order to minimize personnel-induced risks and related costs while at the same time enhancing operational efficiency, it is essential to choose personnel whose qualifications best match the ship/cargo type. There are many officers of the watch (OOW) with different qualifications and educational histories in the maritime sector. Choosing the most suitable among these OOWs specific to the ship/cargo is more difficult than the selection of masters. In the light of this, this study focuses on an appropriate selection process of OOWs and aims to identify the predominant selection criteria according to two main types of vessel: tankers and general cargo ships. The priorities of selection criteria based on the type of vessel are outlined for employing the OOW. Analytical Hierarchy Process (AHP) is used to determine the relative weights of OOW selection criteria. The study concludes that the global relative weight distributions of criteria for tankers and general cargo ships are quite different from each other, except for experience. It is thought that the criteria determined will provide companies with a more accurate evaluation advantage in the selection of OOWs.

Keywords: Ship Personnel Selection, AHP Method, Tankers, General Cargo Ships, Officer of the Watch

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1. Introduction

Human error is one of the most frequent causes of maritime accidents. Between the years 2000 and 2018, human error accounted for over 90% of all ship accidents (Pense, 2018). In order to minimize human-induced risk on ships, the International Maritime Organization (IMO) and the International Labor Organization (ILO) introduced the Training, Certification, and Watchkeeping Standards of Seafarers (STCW 78/95) and the Maritime Labor Convention in 2006 (MLC 2006). This ensures that the maritime education being given by various educational institutions around the world is conducted according to STCW. The level of this education differs depending on the type of school, be it private, public, high school, vocational school, or schools which offer graduate degrees. Furthermore, a certain amount of training is needed to keep up with the updates in maritime education even after working on board after graduation. The licenses and certificates that are given to seafarers at the end of these training sessions indicate their competence to work at sea. Although all personnel working on board have the qualifications to work aboard ship, their operational performance depends on their personal characteristics and qualifications as well.

Since a ship is a closed structure, human relations on board and the process of adaptation to the ship are important issues. Moreover, ship operations carry many risks owing to their nature and the ship crew plays a great part in the emergence and/or prevention of those risks. Hence, the personal characteristics of seafarers are important in regard to maritime safety. The qualifications of ship personnel affect all stakeholders in maritime transport such as insurance companies, financial investment companies as well as ship owners and operators. Therefore, choosing appropriate personnel for the ship becomes an important issue.

Shipping companies may have a different number of vessels in their fleet. The technical characteristics of the ships in each fleet, the types of cargo they carry, and the routes they travel are very different from each other. Depending on these factors, the ship operation processes and the operational risks may differ. Accidents caused by dangerous goods are particularly common on ships. In this respect, it is important to select the ship's personnel by determining appropriate criteria specific to the ship/cargo type in terms of increasing operational efficiency, minimizing human-induced risks, and related costs.

Maritime companies generally select the crew for ships through subjective or objective methods. Due to their limited number, it is often an easy matter for companies to choose suitable masters who are already specialized in one type of cargo and who have previous experience. However, the selection of the most suitable OOW is no easy matter, as there are high numbers of OOWs with different educational histories and qualifications in the maritime industry. Added to this, most of them are recent graduates. In this respect, in order to manage the process well, it is necessary to develop decision methods specific to the ship/cargo type for the selection of OOWs.

Although various academic studies on the selection of ship personnel have been carried out, only a few of them deal with selecting the appropriate personnel for a particular ship

type. However, there is no research that focuses on the selection criteria of OOWs based on type of ship. Most of the approaches used in these studies make it difficult to assess applicants in practice because of the high number of criteria determined. More selective and practical decision methods specific to the ship/cargo type are needed for companies to choose suitable OOWs.

In this context, this study aims to determine the selection of appropriate OOWs in terms of type of vessel. The ship types were categorized under two main groups: tankers and general cargo ships. The study particularly aims to identify the predominant criteria in the selection of OOWs. Due to the specific requirements, it is inevitable that there will be differences in the OOW selection criteria of these ship types. In this regard, a questionnaire was conducted with maritime companies in Turkey. The relative weights of the criteria related to the selection of OOWs are determined using the AHP method. Thus, the criteria priorities for both ship types are discussed comparatively and the required qualifications of OOWs are also determined according to the type of ship. The unique feature of this study is that different criteria based on ship types are proposed in order to provide shipping companies with a more effective OOW selection process.

2. Literature review

Various academic studies related to human resources and personnel selection in the maritime industry have been carried out and multi-criteria decision-making (MCDM) approaches are used in these studies for the assessment of the applicants. Acer and İnci (2020) conducted a study on the selection of personnel for port yard operations. They evaluated six main criteria and 27 sub-criteria in their study using the AHP-based MOORA (Multi-objective Optimization on the basis of Ratio Analysis) method and selected the most ideal applicant for yard operations. By addressing the problem of personnel selection in a port operation, Efe and Kurt (2018) created a decision-making model using AHP and fuzzy TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) applications. They offered distance and similarity-based solutions to port management in the selection of human resources experts.

In addition to these studies related to port management, various other studies are concerned with the selection of ship personnel. However, most of these deal with the selection of seafarers without specifying their particular duties. Furthermore, these studies do not take into account the type of ship that personnel work on. Ertürk et al., (2017) conducted a study on the determination of the recruitment process required by personnel departments of maritime companies regarding the stages of recruitment. Ding and Liang (2005) conducted a study for the selection of seafarers of Taiwan-flagged ship owners. The Binary Logit Model was used for the selection of seafarers. In the study, seafarer selection was made using 16 different factors. Koutra et al. (2017) used the AHP method to approach candidate recruitment processes by addressing the issue of multiple criteria selection in the Greek maritime industry and the selection of seafarers in the maritime sector. They introduced a new criterion sorting technique based on Correspondence Analysis (CA) using a powerful data-based approach that does not rely on priority scales to pick the highest-evaluated criteria. Wang and Tae Yeo (2016) conducted a study on the selection of seafarers from

other countries to work on Korean flagships. Delphi, Fuzzy AHP, and Fuzzy TOPSIS were the employed methods in the study. During the study, seafarers from five countries were evaluated according to 15 criteria.

Unlike the studies outlined above, Celik et al., (2009) conducted research which focused particularly on the selection of masters for ships. In the study, they used four main criteria and 28 sub-criteria for the master selection using the ANP (Analytic Network Process) method. As a result of the study, they proposed a model for maritime companies and proposed to develop a computer-based test and a human-based interview. Different from all the studies that do not make a distinction regarding ship type, Fışkın and Zorba (2015) dealt with personnel selection criteria for tankers that are leased by Major Oil Companies (MOC). They used the weighting scoring method with the data obtained verbally from 12 tanker company officials. Their study showed that tanker ship experience, foreign language, and references are the most important selection criteria for candidates hoping to work on tanker ships. Another study on tankers was carried out by Elidolu et al., (2020). Using the fuzzy AHP method they proposed a solution to a tanker company regarding which criteria should be highlighted in the recruitment of a captain and which of the candidates would be the most suitable.

Similar to this study, there are several other studies that deal with OOWs specifically. However, the main focus of their research was not the selection of appropriate OOWs for the type of vessel. Kececi et al., (2015) studied the performance evaluation of ship officers employed by shipping companies. They considered 34 variables which are grouped into nine categories regardless of ship type. Another study carried out by Uğurlu (2015) researched the problem of appropriate ship selection of graduate officers. Uğurlu developed a model that determines which ship is selected by officers using the fuzzy AHP method. Kartal et al. (2019) proposed a model to identify the qualifications of an ideal OOW by comparing multinational officers. They used the fuzzy AHP method to compare officers from chosen countries and determined main and sub-criteria for both positive and negative aspects.

Unlike the studies mentioned above, the scope of this study is the appropriate OOW selection specifically for the two main ship types.

3. Methodology

Priorities of OOW selection criteria were determined specific to the type of vessel. For this aim, ships were divided into two main groups, namely a group of tankers (GoT) and a group of general cargo ships (GoG), according to the characteristics of transported cargo. In the study, GoT includes Chemical and LPG ships, and GoG consists of Container, Dry cargo, and Ro-Ro. In this regard, a questionnaire was conducted to determine the criteria and the priorities that maritime companies consider in the selection of OOWs. The general methodology for determining OOW selection criteria is given in Figure 1. This methodology is valid for both groups of ships.

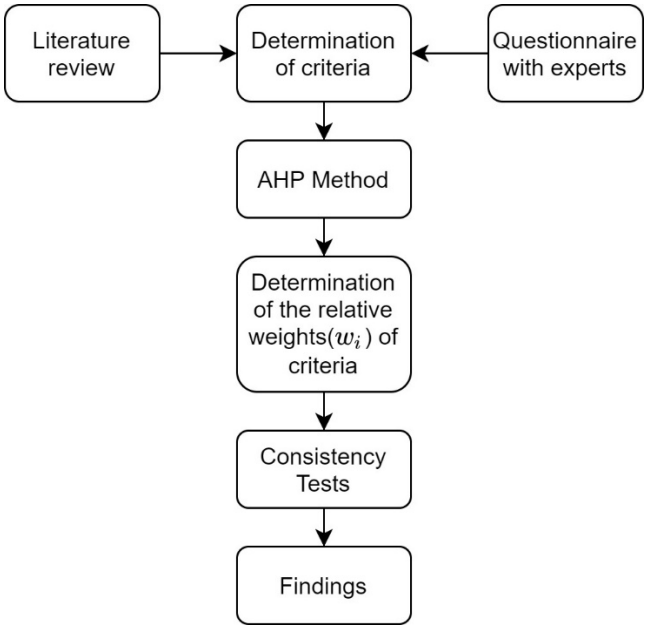

Figure 1. Methodology for determining OOW selection criteria

AHP method was used to determine the relative weights of OOW selection criteria as specific to the ship type and the relative criteria weights were calculated using the Expert Choice program. AHP is a mathematical method that can evaluate both quantitative and qualitative variables at the same time and enables the qualitative criteria to be converted into quantitative. AHP also allows decision-makers to model complex problems in a hierarchical structure that shows the relationship between the main criteria, sub-criteria and alternatives (T. Saaty & Vargas, 2012). Since the criteria for the selection of personnel are of a qualitative nature AHP can be used to transform these criteria into a quantitative structure in order to develop a more objective perspective (Ilgaz, 2018).

3.1. Determination of criteria and sub-criteria

In order to determine criteria and sub-criteria, twenty human resource managers working in Turkish maritime companies and involved in the selection of OOWs were contacted. They were selected from the personnel departments of major shipping companies and they all have at least ten years of experience in the shipping industry. All of them have maritime-related university degrees. When selecting them, we also took into account the type of ship that their company has and the number of seafarers employed in these ships. Out of twenty companies, one has ten general cargo ships, another has eight tanker ships, and the rest of the companies have an average number of five ships. The distribution of the number of seafarers is similar to the number of vessels. Table 1 shows both the total number of ships and the number of seafarers employed by these companies. Data was collected via online or face-to-face semi-structured interviews. The personnel selection criteria in the literature was discussed and then a questionnaire to determine the specific OOW criteria and the hierarchy of criteria was conducted with the experts. Open-ended questions were also included in the questionnaire.

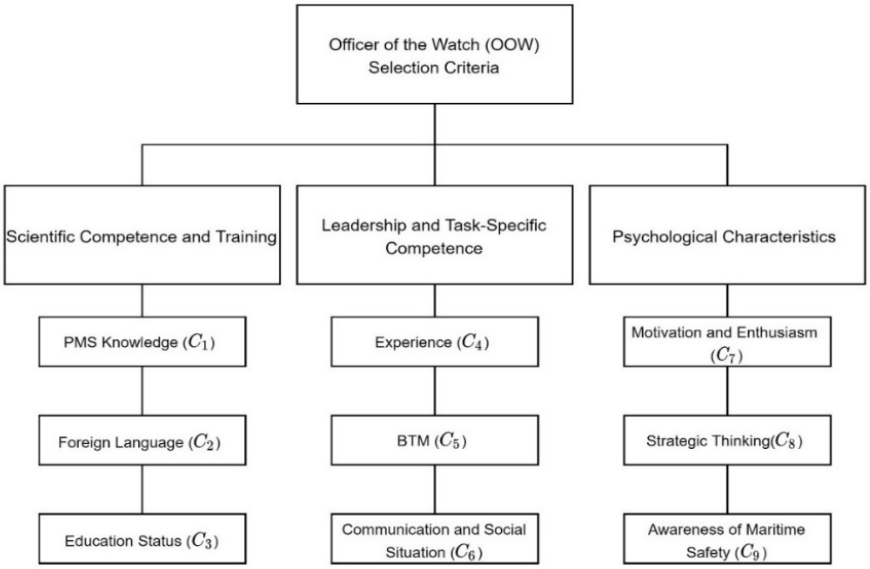

Figure 2. OOW selection criteria.

Table 1. Total number and type of ships of the companies

Type of Ship	Number of Companies	Number of Ships	Total Number of Seafarer Employment
Group of Tankers	10	50	1123
Group of General Cargo Ships	10	53	1078

To determine the deck officer selection criteria, the studies of Celik et al., (2009); Cicek, Akyuz, & Celik, (2019); Efe & Kurt, (2018); Fışkın & Zorba, (2015); Kartal et al., (2019); and Koutra et al., (2017) were comprehensively examined to find out the criteria used in the maritime industry. While some of the criteria in these studies were common such as experience, educational status, foreign language and communication skills, there were several differences in many of the criteria and also in their classification. Due to the need for criteria specific to OOW selection as well as these differences, the main and sub-criteria were determined and classified according to the interviews with the experts.

Consequently, three main criteria were identified as being relevant in the selection of OOWs. These main criteria are scientific competence and training, leadership and task-specific competence, and psychological characteristics. Three sub-criteria were determined for each of these main criteria. The identified main criteria and sub-criteria are shown in Figure 2. Explanations about the main and sub-criteria are also given in Table 2.

Table 2. Explanations of main and sub-criteria.

Scientific Competence and Training	This refers to the education level obtained by the OOW and competence in the knowledge of the planned maintenance system (PMS) used in ships in parallel with foreign language knowledge and skills in technology .
PMS Knowledge (*C1*)	This involves knowing the PMS planned maintenance system, making data entries, and following the departments that are responsible for the ship.
Foreign Language (*C2*)	Demonstrates the officer's ability to speak and write in maritime English.
Education Status (*C3*)	The quality of the diploma he/she received from the last school he/she studied (High School – undergraduate - graduate – postgraduate)
Leadership and Task-Specific Competence	This can be defined as the leadership competencies of the OOW in terms of Bridge Team Management (BTM) and communication skills on board as well as his/her previous sea experience.
Experience (*C4*)	Refers to the length of time that the officer was on the same mission and total sea experience on board. It also includes job references.
Bridge Team Management (*C5*)	This refers to the consistency and level of knowledge about teamwork with other watchkeeping officers on the bridge, thus ensuring safe navigation and properly implemented bridge team management procedures.
Communication and Social Situation (*C6*)	This demonstrates the high level of cooperation and understanding of the officer during the work on board. It includes rules for interpreting the social interactions of officers in the ship environment.
Psychological Characteristics	This is related to the main characteristics and personality traits of the OOW combined with their occupational experience.
Motivation and Enthusiasm (*C7*)	These are the driving forces that encourage employees to mobilize and pursue goals in the ship environment.
Strategic Thinking (*C8*)	This demonstrates an important reasoning feature in making personal and professional decisions. It refers to a deliberate and rational thought process that focuses on the analysis of critical factors and variables that will affect the long-term success of a ship bridge team or an individual.
Awareness of Maritime Safety (*C9*)	In addition to the knowledge of the basic maritime rules that the officer has learned at the school he/she graduated from, he/she demonstrates his/her ability to adapt to the new maritime safety rules developed as a result of technological developments.

3.2. Determination of the relative weights of criteria

To determine the relative weights of criteria using AHP, it is first necessary to create the pairwise comparison matrix (A_{nxn}) such as the one below that indicates the relative importance of the criteria (Saaty and Vargas 2012).

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ a_{21} & 1 & \dots & a_{2n} \\ \vdots & \vdots & \dots & \vdots \\ \vdots & \vdots & \dots & \vdots \\ a_{n1} & a_{n2} & \dots & 1 \end{bmatrix} \quad (1)$$

Where the element (a_{ij}) denotes the relative importance of the i-*th* criteria compared to the j-*th* criteria (i,j=1,……,n). a_{ij} is determined based on the scores of experts using the 1-9 importance scale given in Table 3. If the value of the element a_{ji} in this matrix is k,

Table 3. 1-9 importance scale (Saaty 1990).

Intensity of importance	Explanation
1	Two activities contribute equally to the objective
3	Experience and judgment slightly favor one activity over another activity
5	Experience and judgment strongly favor one activity over another activity
7	Activity is favored very strongly over another
9	Evidence that favors one activity over another has the highest possible level of affirmation.
2,4,6,8	Intermediate values

a_{ji} will be equal to 1/k.

Then, to formulate the normalized pairwise comparison matrix (B_{nxn}) the pairwise comparison matrix (A_{nxn}) is normalized by the following equation,

$$b_{ij} = a_{ij} / \sum_{i=1}^{n} a_{ij} \quad (2)$$

The relative weights of the criteria are the average of the row elements of the normalized pairwise comparison matrix (B_{nxn}) That is, the relative weight of *i-th* criteria (Wi) is calculated as follows,

$$w_i = \frac{1}{n} \sum_{j=1}^{n} b_{ij} \quad (3)$$

To test the (CR) consistency degree of the pairwise comparison matrix, the consistency ratio must be calculated as follows,

$$CR = CI/RI \quad (4)$$

RI and *CI* are the random index value and the consistency index value for the matrix (A_{nxn}) respectively. The random index value *RI* can be determined using the table of random index values or the following equation,

$$RI = \frac{1.98\,(n-2)}{n} \quad (5)$$

The consistency index value *CI* is calculated by the following equation,

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (6)$$

where, λ_{max} is the largest eigenvalue. If the *CR* value is less than 0.1, the pairwise comparisons are consistent (Taha 2017; Saaty and Vargas 2012). Otherwise, the analysis should be reviewed from the beginning and rearranged with different values if necessary.

4. Results

The relative importance score of each criterion in the pairwise comparison matrix is determined based on the arithmetic mean of the scores given by the experts. These scores given by each expert are very close to each other. The main criteria relative weights of GoT and GoG that are calculated based on the pairwise comparison matrices are given in Table 4. The criterion psychological characteristics has the least relative weights value with 0.21 and 0.24, respectively for both GoT and GoG. Leadership and task-specific competence has the highest relative weights value with 0.54 for GoT and 0.45 for GoG.

Table 4. Main criteria relative weights for GoT and GoG.

Main Criteria	GoT	GoG
	Relative Weights (*w*)	Relative Weights (*w*)
Scientific Competence and Training	0.25	0.31
Leadership and Task-Specific Competence	0.54	0.45
Psychological Characteristics	0.21	0.24

Table 5 shows the sub-criteria relative weights belonging to the main criteria for both groups. While the communication and social situation criterion has the least weight value with 0.13 among the sub-criteria of leadership and task-specific competence for GoT, it also has the least weight value with 0.22 for GoG. Experience, which is another sub-criterion of leadership and task-specific competence, has the highest values with 0.45 and 0.55 respectively for GoT and GoG.

The relative weight of foreign language is 0.49 for GoT and 0.48 for GoG. These values are the highest sub-criterion weights for scientific competence and training. Awareness

Table 5. Sub-criteria weights for GoT and GoG.

Sub-Criteria		GoT	GoG
		Sub-Criteria Weights	Sub-Criteria Weights
	Scientific Competence and Training		
C_1	PMS Knowledge	0.28	0.30
C_2	Foreign Language	0.49	0.48
C_3	Education Status	0.22	0.23
	Leadership and Task-Specific Competence		
C_4	Experience	0.45	0.55
C_5	BTM	0.41	0.23
C_6	Communication and Social Situation	0.13	0.22
	Psychological Characteristics		
C_7	Motivation and Enthusiasm	0.24	0.37
C_8	Strategic Thinking	0.15	0.54
C_9	Awareness of Maritime Safety	0.59	0.08

of maritime safety has the highest relative weight with 0.59 among the sub-criteria of psychological characteristics for GoT. Its value is 0.08 for GoG. The sub-criterion having the highest relative weight among the sub-criteria of psychological characteristics is strategic thinking with a value of 0.54 for GoG.

The main criteria consistency ratios of pairwise comparison matrices for GoT and GoG are calculated as 0.0021 and 0.0070 respectively. Also, sub-criteria consistency ratios are shown in Table 6 for GoT and GoG. It can be seen that all ratios are less than 0.1 which means they are consistent.

Table 6. Consistency ratio of pairwise comparison matrices for GoT and GoG.

Pairwise comparison matrices	GoT	GoG
	Consistency Ratio	Consistency Ratio
Scientific Competence and Training	0.0669	0.0020
Leadership and Task-Specific Competence	0.0247	0.0530
Psychological Characteristics	0.0433	0.0750

Global relative weights of sub-criteria and selection ranks are given in Table 7. Experience has the highest global relative weight value with 0.243 and is ranked in first place in the selection for GoT. BTM is the second with 0.222 and awareness of maritime safety is the third with 0.125. Strategic thinking has the lowest global relative weight value with 0.035. Experience has the highest global relative weight value with 0.247 and it is ranked in the first place of selection for GoG as well. Foreign language with 0.148 has the second-highest value. Strategic thinking comes third with 0.130 for GoG.

Table 7. Sub-criteria global relative weights and ranking.

	GoT		GoG	
Sub-Criteria	Sub-Criteria Global Relative Weights	Ranking	Sub-Criteria Global Relative Weights	Ranking
PMS Knowledge (C_1)	0.075	5	0.093	6
Foreign Language (C_2)	0.123	4	0.148	2
Education Status (C_3)	0.056	7	0.071	8
Experience (C_4)	0.243	1	0.247	1
BTM (C_5)	0.222	2	0.103	4
Communication and Social Situation (C_6)	0.069	6	0.099	5
Motivation and Enthusiasm (C_7)	0.052	8	0.090	7
Strategic Thinking (C_8)	0.035	9	0.130	3
Awareness of Maritime Safety (C_9)	0.125	3	0.019	9

5. Discussion

Scientific competence and training, leadership and task-specific competence, and psychological characteristics were determined as the main criteria for the selection of qualified OOWs. These are general criteria that indicate the characteristics of applicants in other sectors as well. Similarly, most of the sub-criteria are common personnel selection criteria. However, due to the nature of maritime transport, compliance with these criteria is more important than it is in other sectors. PMS knowledge, awareness of maritime safety, and BTM are specific only to maritime companies.

When the relative weight values of the main criteria are examined, it is seen that although the relative weights of the main criteria for GoT and GoG are different from each other, their ranking by importance is the same as each other. Leadership and task-specific competence is the most important main criterion for both groups. However, while the relative weight of this criterion for GoG is not much different from that of scientific competence and training, the relative weight of it for GoT is at least twice as high as for the other main criteria. This result demonstrates that leadership and task-specific competence is more important for GoT than for GoG.

The importance ranking of the sub-criteria of leadership and task-specific competence for both GoT and GoG is the same. Experience is the most important sub-criterion for both. However, the relative weight values of all sub-criteria are very different from each other. The most significant difference is observed between their BTM criteria. Namely, BTM and experience have nearly the same relative weight value for GoT, while the relative weight value of the experience for GoG is at least two times higher than BTM. The relative weight values of all the sub-criteria of scientific competence and training for GoT are almost the same as those for GoG. It is noted that foreign language is the most important sub-criterion for both GoT and GoG. The relative weight values of the sub-criteria of psychological characteristics for GoT and GoG are quite different from each other. Even though awareness of maritime safety for GoT is the predominant sub-criterion among other sub-criteria of psychological characteristics, it has the least importance for GoG. Similarly, strategic thinking has the highest relative weight value for GoG but it is the least important sub-criterion among other sub-criteria of psychological characteristics for GoT.

As for the global relative weight values of the sub-criteria, this study shows that there are differences in the ranking of sub-criteria between GoT and GoG except for experience. Naturally, experience is the most important sub-criterion that plays a role in the selection of OOWs for both GoT and GoG as it reflects expertise according to the type of cargo. Although the relative weight of it is almost the same for both GoT and GoG, the effects on the total score differ from each other. While it has a 24.7% effect in calculating the total score, all other criteria effects vary between 14.8% and 2%. Moreover, it has almost the same effect as BTM in determining the total score for GoT. This means that the experience score of the applicant significantly determines the total score for GoG. However, BTM has as much effect as experience in determining the score for GoT. This can be explained by the fact that BTM plays an important role in MOC inspections. The finding of this study regarding experience complies with the results of the previous study of Fışkın and Zorba (2015) about ship personnel selection for tankers. Namely, experience was the most important criterion in this study as well. This study shows that foreign language knowledge is second in the ranking for GoG, while it is fourth in the ranking for GoT. However, its effect in determining the total score is approximately the same for both.

The sub-criterion which showed distinct differences between GoT and GoG is that of strategic thinking. It is the least important sub-criterion for GoT, while it ranks as the third in the importance ranking for GoG. That is, although its effect in the determination of the total score is about 13% for GoG, this value for GoT is 3%. This might lead to the

conclusion that strategic thinking is not important for GoT because tanker operations are carried out according to the procedures. However, seamanship knowledge is used more during cargo operations in GoG, especially in any problematic situation. Another critical distinguishing sub-criterion is awareness of maritime safety. It is placed as third in the importance ranking for GoT and its effect on the total score is about 12.5%. However, it is the least important sub-criteria for GoG and it has only a 2% effect in determining the total success score. Due to the nature of the cargoes transported, issues related to maritime safety are much more important in GoT when compared to GoG. Therefore, it is requisite that the OOWs have awareness of maritime safety. There are many rules for the transportation of dangerous goods such as the International Safety Guide for Tankers and Terminals (ISGOTT), International Bulk Carrier (IBC) code, International Maritime Dangerous Goods Code (IMDG), United State Coast Guard (USCG) rules, and Liquefied Gas Handling Principles on Ships and in Terminals (SIGTTO) in addition to the International Convention for the Prevention of Pollution from Ships (MARPOL) and the International Convention for the Safety of Life at Sea (SOLAS) which regulate basic maritime rules. Accordingly, GoT is subjected to many strict commercial inspections. On the other hand, in GoG, it is sufficient to comply with MARPOL and SOLAS, which include only Port State Controls. In this respect, awareness of maritime safety by OOWs is very important for GoT.

Regarding the criterion of PMS knowledge, there is a difference of about 2% between GoT and GoG. Similarly, education status is nearly the same for the two groups. This means that, between GoT and GoG, neither of these are distinctive criteria for selecting OOWs . The effect of communication and social situation in determining the total score for GoG is 3% higher than for GoT. This result can be explained by the fact that GoT works between closer ports and there are shorter transit times as well as shorter waiting times at ports. Like communication and social situation, there is a small difference between GoT and GoG in motivation and enthusiasm.

Some of the criteria determined in this study are document-based and others are (objective and subjective) qualitative and quantitative criteria. Therefore, in order to quantitatively evaluate applicants' scores for each criterion, different assessment methods such as the scale of importance and rating out of 100 points can be used. For example, the performance of applicants according to education status and experience might be evaluated by a point given out of 100 for each level. Similarly, the performance of the applicant for other criteria might be determined out of 100 by examination or psychoanalytic tests as well. In addition, the performance of the applicant during her/his education may be taken into account with a determined score. In this respect, it is thought that using these criteria would provide a more accurate evaluation advantage and be practical for companies. In practice, pre-joining familiarization training is applied to all OOWs before their embarkment on related ships. Selecting appropriate and qualified OOWs would increase the effectiveness of the familiarization and reduce training time.

Although maritime education has global standards, the prolongation of the time from graduation or internship to starting date of employment requires that some information

be updated. Besides, some types of special ships need different certifications compared to standard vessels. Therefore, additional training can be given to the OOW candidates regarding the determined criteria for the necessary ship type, either in training institutions or in the training departments of companies. This will minimize the possible risks on the ship that may arise from the inexperience of OOWs.

In terms of personnel departments, especially if OOWs will have their first work experience on a vessel, the selection process should be done more accurately. Personnel changes are costly and not frequent due to the closed working environment of ships. For this reason, OOW candidates who will be assigned to the ship for the first time should be recruited more carefully than experienced officers.

In the study, the practice of ranking OOWs according to the total score was deemed unnecessary. That is to say, the main task of the study was to determine the dominant evaluation criteria according to the type of ship. However, in future research, OOW applicants could be ranked easily using multi-criteria decision-making methods such as AHP or/and TOPSIS, VIKOR or the weighted total method. The advantages and disadvantages of these methods as well as the features of the criteria should also be considered. An application with real data would allow the results to be compared with each other and the best method to be found. Thus, maritime companies can make the OOW evaluations more objectively with a quantitative evaluation.

6. Conclusions

This paper has determined the selection criteria for OOWs and the priorities of those criteria by maritime companies based on the ship types. The criteria determined in the study also reveal the qualifications that should be possessed by OOWs according to the type of vessel. The study concludes that although the main criteria priorities by maritime companies based on ship types are the same as each other, their relative weights are a little different from each other. The most important main criterion for both GoT and GoG is leadership and task-specific competence. The sub-criteria priorities of leadership and task-specific competence and scientific competence and training are the same for GoT and GoG despite the difference in the relative weight distribution. However, the sub-criteria priorities of psychological characteristics for GoT and GoG are significantly different from each other. While awareness of maritime safety is the predominant sub-criterion for GoT, it is strategic thinking for GoG.

The global relative weight distributions of sub-criteria of GoT and GoG are quite different from each other, except for experience. The results of this study demonstrate that experience is the most important sub-criterion in the selection of OOWs for both GoT and GoG. However, while experience has a predominant role in the determination of the total score for GoG, experience and BTM have an almost equal impact on GoT. Other sub-criteria having an important effect on GoT are awareness of maritime safety and foreign language. As for GoG, the prominent sub-criteria are foreign language, strategic thinking, and BTM. This study shows that the relative weights of other sub-criteria for GoG are not very different from each other, except for the awareness of maritime safety which has the least importance.

In this study, a multi-criteria decision support model was presented to help managers working in the personnel departments of maritime companies, especially in the selection process of OOWs. One of the unique aspects of the study was to develop the model through two main ship types so as to investigate the differences of the criteria compared to each ship type. Hence, it was found that all criteria did not have the same importance for GoT and GoG. For this reason, the importance of the selection criteria should be considered according to ship type.

This study showed that the proposed criteria for the assessment of OOWs should be practical and analytical in order to help managers make more accurate decisions. In this regard, the selection of qualified OOWs according to the type of ship would ensure maritime safety by minimizing human-induced risks and errors. Although the study proposes a model for only OOW selection, in future studies it could be extended to other ship personnel by determining new criteria.

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References

Acer, A., & İnci, H. (2020). Personel Seçimi Sürecinin AHP Tabanlı MOORA Yöntemi ile Değerlendirilmesi: Liman Saha Operasyon Elemanı Seçimi Üzerine Bir Uygulama. *OPUS Uluslararası Toplum Araştırmaları Dergisi*, *16*(29 Ekim Özel Sayısı), 1–1. https://doi.org/10.26466/opus.716542

Celik, M., Er, I. D., & Topcu, Y. I. (2009). Computer-based systematic execution model on human resources management in maritime transportation industry: The case of master selection for embarking on board merchant ships. *Expert Systems With Applications*, *36*, 1048–1060. https://doi.org/10.1016/j.eswa.2007.11.004

Cicek, K., Akyuz, E., & Celik, M. (2019). Future Skills Requirements Analysis in Maritime Industry. *Procedia Computer Science*, *158*, 270–274. Elsevier B.V. https://doi.org/10.1016/j.procs.2019.09.051

Ding, J. F., & Liang, G. S. (2005). The choices of employing seafarers for the national shipowners in Taiwan: An empirical study. *Maritime Policy and Management*. https://doi.org/10.1080/09523980500062643

Efe, B., & Kurt, M. (2018). Bir Liman İşletmesinde Personel Seçimi Uygulaması. In *Karaelmas Fen ve Mühendislik Dergisi* (Vol. 8). Zonguldak Bülent Ecevit Üniversitesi: Bulent Ecevit University. https://doi.org/10.7212/zkufbd.v8i2.750

Elidolu, G., Uyanık, T., & Arslanoğlu, Y. (2020). Seafarer personnel selection with Fuzzy AHP. *5th International Mediterranean Science and Engineering Congress (IMSEC 2020)*, 632–636. Antalya.

Ertürk, A., Demirel, O., & Polat, M. (2017). A holistic approach for HR selection and placement process: A model proposal for maritime industry. *Journal of Naval Sciences and Engineering*, *13*(2), 1–13.

Fışkın, R., & Zorba, Y. (2015). An Analysis of The Effects of Major Oil Companies on Crew Selection Criteria for Tanker Operating Ship Management Companies. *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, *7*(2), 154–170.

Ilgaz, A. (2018). Lojistik Sektöründe Personel Seçim Kriterlerinin Ahp ve TOPSIS Yöntemleri ile Değerlendirilmesi. *Journal of Süleyman Demirel University Institute of Social Sciences*, *3*(32), 586–605.

Kartal, Ş. E., Uğurlu, Ö., Kaptan, M., Arslanoğlu, Y., Wang, J., & Loughney, S. (2019). An analysis and comparison of multinational officers of the watch in the global maritime labor market. *Maritime Policy & Management*, *46*(6), 757–780. https://doi.org/10.1080/03088839.2019.1597290

Kececi, T., Bayraktar, D., & Arslan, O. (2015). A Ship Officer Performance Evaluation Model Using Fuzzy-AHP. *Journal of Shipping and Ocean Engineering*, *5*(1). https://doi.org/10.17265/2159-5879/2015.01.004

Koutra, G., Barbounaki, S., Kardaras, D., & Stalidis, G. (2017). A Multicriteria Model for Personnel Selection in Maritime Industry in Greece. *2017 IEEE 19th Conference on Business Informatics (CBI)*, *1*, 287–294. IEEE. https://doi.org/10.1109/CBI.2017.52

Pense, C. (2018). Deniz kazalarında insan faktörü ve bir çözüm olarak e-seyir. *Akıllı Ulaşım Sistemleri ve Uygulamaları Dergisi*, *1*(2), 72–86.

Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*. https://doi.org/10.1016/0377-2217(90)90057-I

Saaty, T., & Vargas, L. (2012). Models, methods, concepts & applications of the analytic hierarchy process. In *... -Driven Demand and Operations Management Models*. Springer. https://doi.org/10.1007/978-1-4614-3597-6

Taha, H. A. (2017). *Operations research an introduction*. © Pearson Education Limited 2017.

Uğurlu, Ö. (2015). Application of Fuzzy Extended AHP methodology for selection of ideal ship for oceangoing watchkeeping officers. *International Journal of Industrial Ergonomics*, *47*, 132–140. https://doi.org/10.1016/j.ergon.2015.01.013

Wang, Y., & Tae Yeo, G. (2016). The Selection of a Foreign Seafarer Supply Country for Korean Flag Vessels. *Asian Journal of Shipping and Logistics*, *32*(4), 221–227. https://doi.org/10.1016/j.ajsl.2016.12.005